Next Generation Coatings presented to US Army Corrosion Summit February 4, 2009

Henkel

Adhesive Technologies

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US Army Corrosion Summit 2009

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A Historical Perspective on Metal Pretreatment

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1906, 1st $FePO_4$ T. Coslett

1910 Zinc Phosphate Introduction

1943 Introduction of Jernstadt "Salt"

1986 Tri-Cationic Zinc Phosphate Today's Standard

1998 First Work on Next Generation Coatings

2002 Replacement for Zinc Phosphate Begins

2001 Replacement for Iron Phosphate Begins

1900 1950 2000

Historical Perspective of Metal Pretreatment

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December 2006
1st OEM trial to replace Zinc Phosphate

November, 2007
1st N. American OEM Conversion

4 Qtr 2008 - 2009
Global Roll Outs Automotive

2005 2006 2007 2008 2009

January 2007
1st Auto Parts Conversion

March 2007
2nd OEM Trial

February 2008
1st S. American OEM Conversion

Why the trend to Change?
Significantly Strong Headwinds

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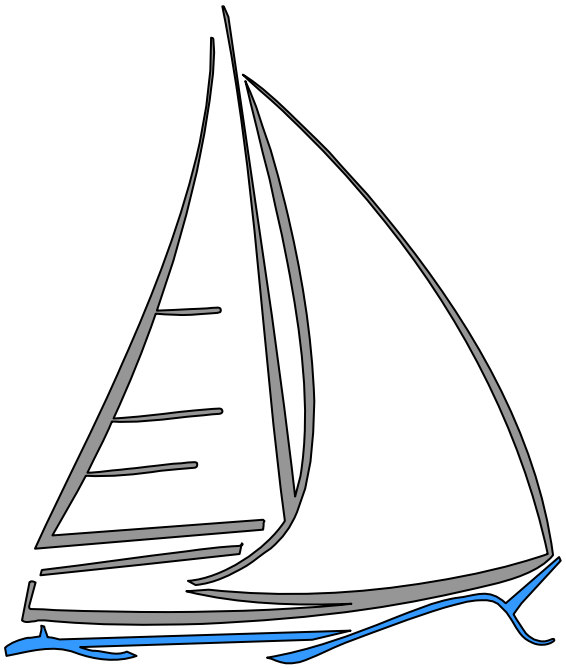

Headwinds

- Raw material price volatility
- Increased logistics and transportation costs
- Increased Energy costs
- Credit crunch
- Increased inflation
- Consumer Confidence Index 5-year low
- Environmental Impact

Source: A.T. Kearney

New Generation Coatings

Objective: **Eliminate conventional iron and zinc pretreatment systems**

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Features:

- Phosphate-free
- Zirconium is not a regulated metal
- Operates at ambient temperature
- Generates very little sludge

Benefits:

- Comply with ever-tightening municipality restrictions
- Minimize waste treatment costs; eliminate need for sludge hauling and clean-outs
- Significantly reduce energy costs
- Lowers operating costs and improves reject rates

- New Generation Coatings are a reactive, rinsable pretreatment that can be used on steel, zinc, and aluminum surfaces.
- New Generation Coatings offer the adhesion and corrosion protection on painted metal surfaces

New Generation Coatings Achieved Pretreatment Goals

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Process Cost
- Shorten Line
- Reduce Water Usage
- Reduce Energy Consumption

Environment
- Eliminate Phosphate
- Significant Sludge Reduction
- Reduce Heavy Metals

Performance
- Meet Customer Specifications

Research & Development

Reaction Chemistry

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Zinc Phosphate Solution
~50% Efficient in the use of Zn

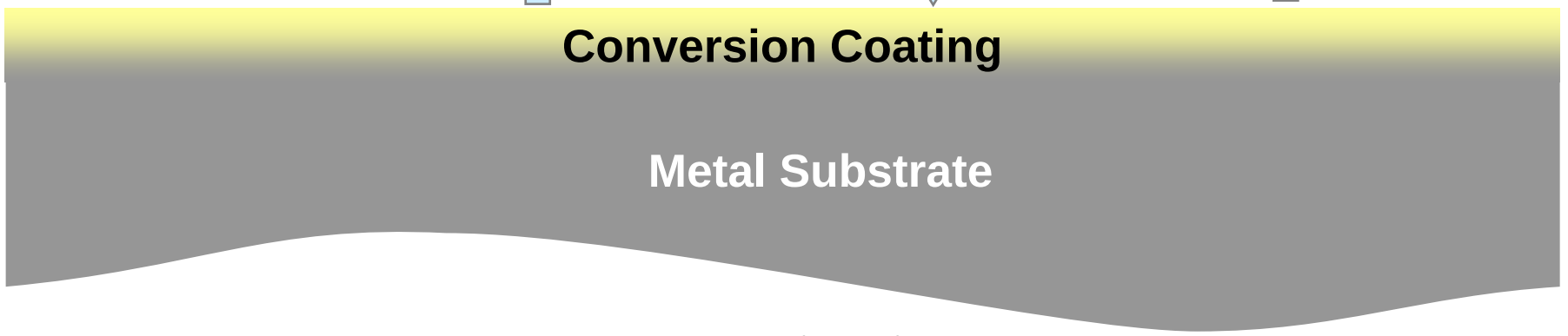
Solid by-products
Solid Waste!

$Zn(H_2PO_4)_2$ $Zn_3(PO_4)_2 + FePO_4$

NGC Solution
~99% Efficient in the use of the bath

Soluble by-products
No Solid Waste

H_2ZrF_6 $Zn^{+2} + F^-$



New Generation Coatings Properties

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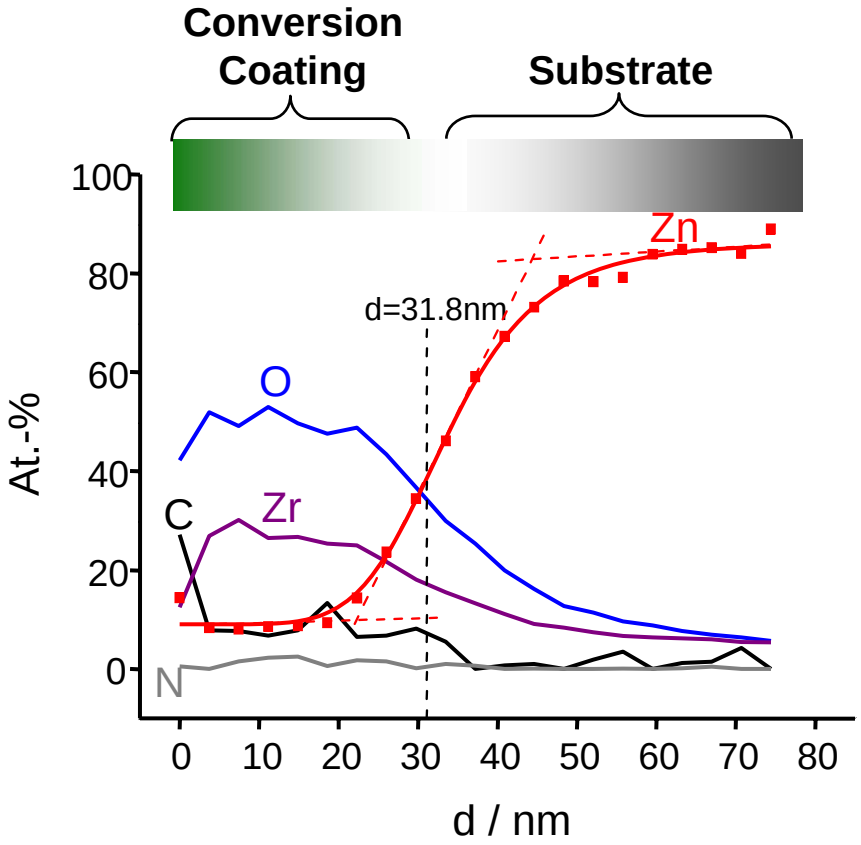
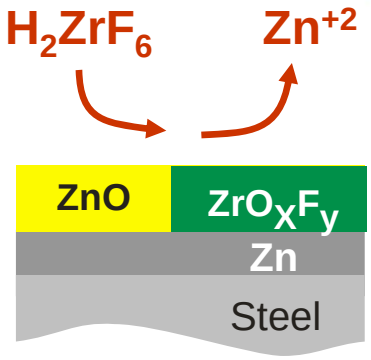


X-ray Photoelectron Spectroscopy (XPS)



- Substrate Electrogalvanized
- Conversion coating thickness: 30 to 50 nm
- Zirconium as oxide/hydroxide is main deposit, with additives and ions from the substrate

New Generation Coatings Properties

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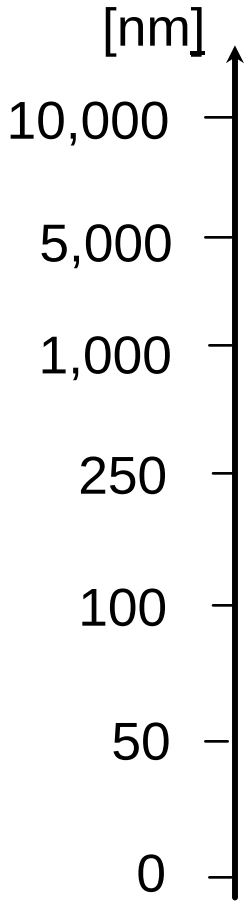
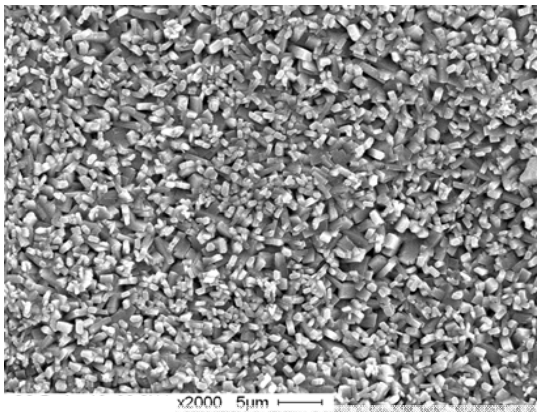
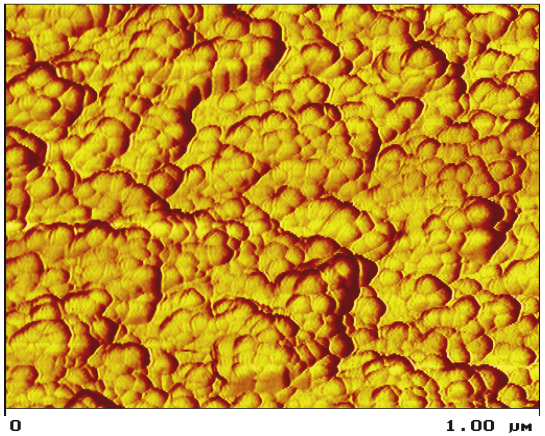


	Coating Weight
Zinc Phosphating	**1 - 4 g/m²**
Iron Phosphating	**~ 600 mg/m²**
Chromating	
New Generation Ctg.	**20 - 300 mg/m²**



SEM - Zinc Phosphate



AFM – New Generation Ctg.

Traditional Vs Next Generation Coating and Operational Comparison

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Characteristic	Iron Phosphate	Zinc Phosphate	Next Generation Coatings
1. pH	4.5 - 5.5	2.8 - 3.5	3.5 – 6.0
2. Composition	Iron oxide/ phosphate	Phosphate of Zn, Fe, Mn, Ni, Co	Nanostructured particles, Ti, V, Zr, Silanes, polymers, or combinations
3. Coating weight (g/m^2)	0.20 – 0.90	1.5 – 4.0	0.06 – 0.10
4. Temperature (°F)	100 - 140	105 - 135	Ambient
5. Conditioning step	No	Yes	No
6. Sludge	Moderate	High	Very minimal
7. Accelerator impact	Increase CW	Decrease CW	N/A
8. Post treatment	Very important	Optional	Not necessary
9. Corrosion protection	Worse than $Zn_3(PO_4)_2$	Standard for High Quality	Meet Performance Specifications

Next Generation Coatings

Performance on Various Paint Systems

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504 hr Neutral Salt Spray

Polyester Powder		Cathodic E-Coat	Epoxy Ester Powder	Urethane Ester Powder	Polyester Powder	Polyester Powder	Acrylic High Solids
0.3 mm	0.2 mm	2.3 mm	3.9 mm	2.2 mm	2.4 mm	2.8 mm	2.3 mm

New Generation Coatings Performance To-Date

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Substrate	Process: Iron Phosphate	Process: Bi-cationic ($Zn_3(P0_4)_2$)	Process: Tri-cationic ($Zn_3(P0_4)_2$)	Process: New Conversion Coatings
Al	n/a	8	9	10
EG	3	8	10	9
HDG	3	6	10	8
Galvannealed	3	8	10	9
CRS	1	5	10	7

Ranking: **1** = very poor, **3** = poor, **5** = acceptable, **8** = good, **10** = excellent

All applications are done **wet-in-wet** using a standard automotive e-coat

Test results are based upon GM 9540P, APGE, VDA, CCT, CASS, NSS, and FFC Test.

Potential Process Layout

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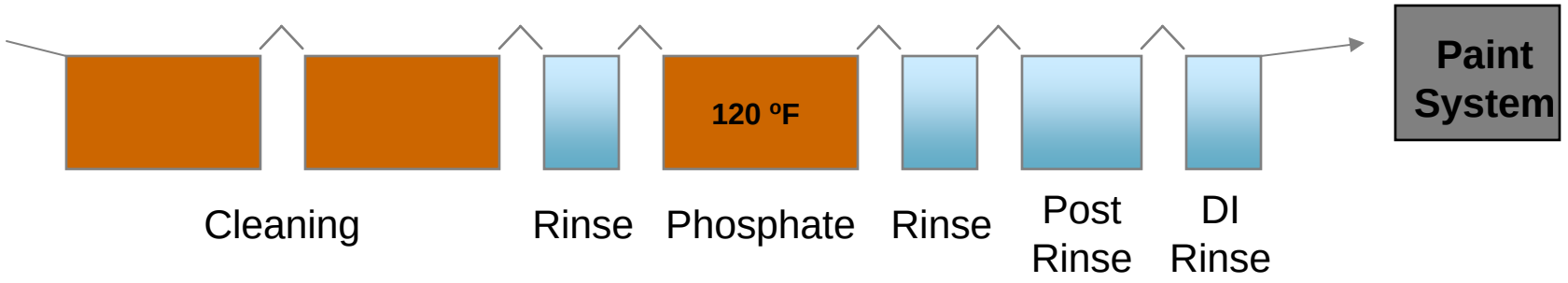
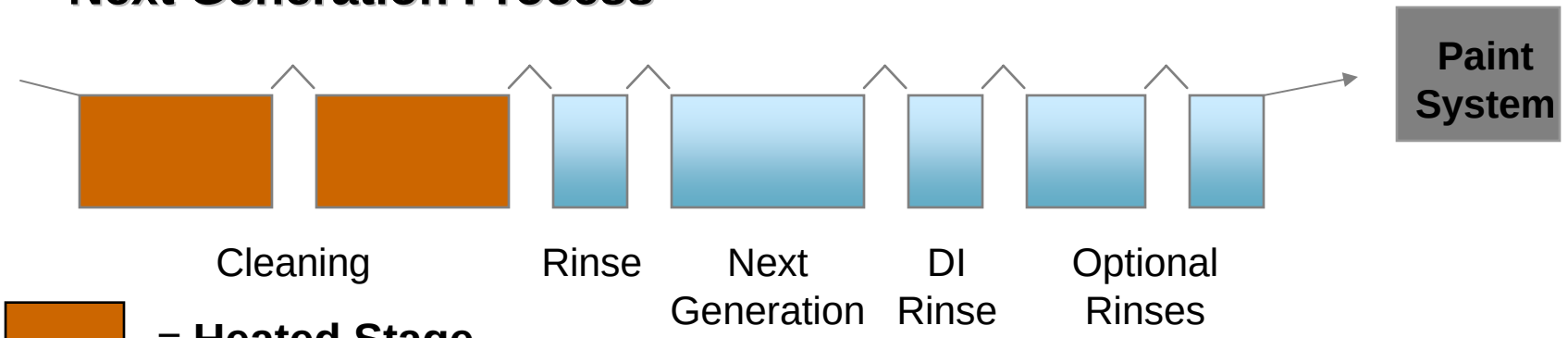
Traditional Iron Phosphate Process



Next Generation Process



= **Heated Stage**

= **Unheated Stage**

Potential Savings: Energy

Water

Waste Treatment

New Generation Coating

Greenfield Process Layout Option

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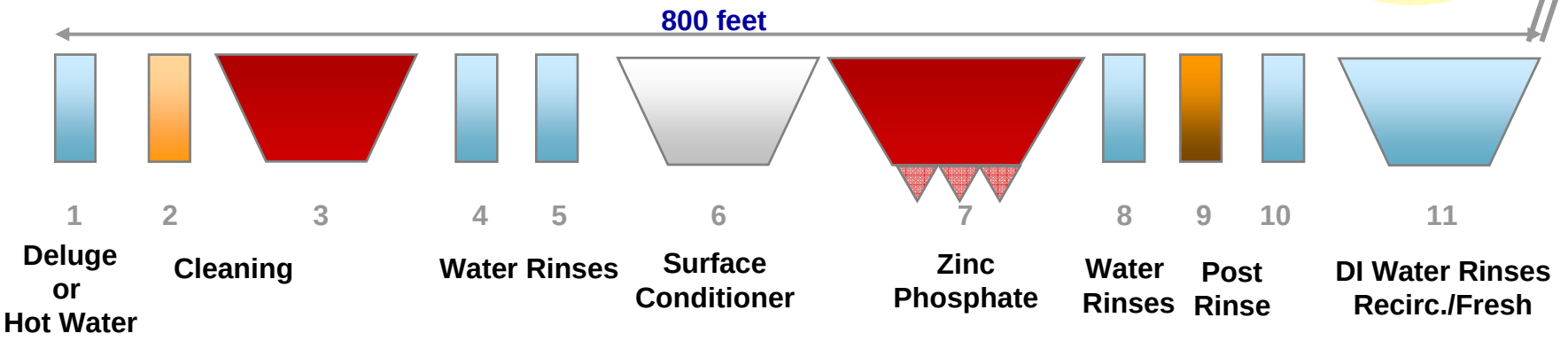
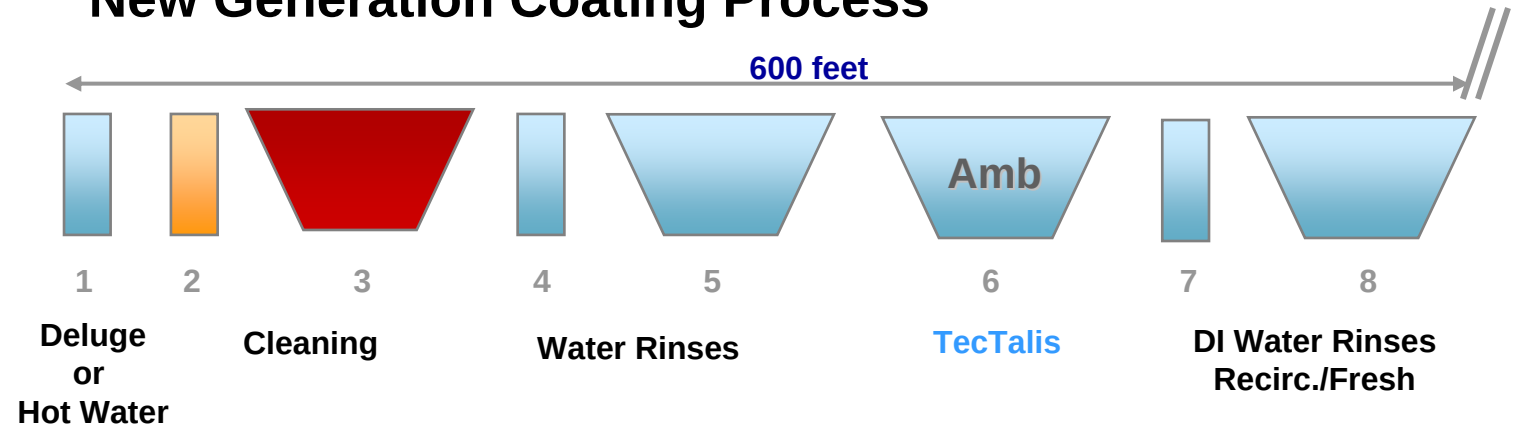
Zinc Phosphating Process



New Generation Coating Process



New Conversion Coatings Potential Cost Savings

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1. **Energy Savings**
   - Reduction in the number of heated stages
2. **Water Savings**
   - Reduction in number of stages, reduced water requirements
3. **Man Power – Labor and Maintenance costs**
   - Reduction in sludge generation
   - Reduction of waste disposal costs
   - Less Clean-outs of the system
4. **Reduction in Floor Space – Greenfield Construction**
   - Reduction in number of stages

Next Generation Coatings
Industries Served

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- Appliance
- Manufacturing Jobbers
- Office Furniture
- Electrical Equipment
- Maintenance Equipment
- Heating & Cooling
- Agricultural Equipment
- General Manufacturing
- Automotive Assembly
- Automotive Components

New Generation Coatings
Military Specification MIL-Std-171

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Current Approved under MIL-Std-171

5.1 - Phosphate Paint Base Coatings

- 5.1.1 Zinc Phosphate base – TTC 490 Type I, Spray and Immersion
- 5.1.2 Iron Phosphate base – TTC 490, type II or IV
- 5.2 Pretreatment coating, TTC 490, type III (wash primer)
- 5.3 Heavy Phosphate Coatings
- 5.3.1 Manganese Phosphate base, DOD-P-16232, type M.

Proposed under MIL-Std-171

5.1 - Phosphate Paint Base Coatings

- 5.1.1 Zinc Phosphate base – TTC 490 Type I, Spray and Immersion
- 5.1.2 Iron Phosphate base – TTC 490, type II or IV
- 5.1.3 Heavy Zinc base – TTC 490, type V
- 5.1.4 New Generation Coatings (Nano), TTC 490, type IV
- 5.2 Pretreatment coating, TTC 490, type III (wash primer)
- 5.3 Heavy Phosphate Coatings

New Generation Coatings

use under TTC 490 Proposed Changes

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What is the requirement (callout) on the drawings?

3.2.1 Submit proposed written procedure per contract. Type I and V

3.2.2 Submit test panels processed to the proposed procedure

1. **Define the process change with the new coating complete with process controls.**
2. **Rewrite written procedure an process panels to the revision**
3. **Test New System – 3 sets of 3 panels per set**
    1. **Pretreatment for visual appearance**
    2. **Pretreatment/primer panels check film thickness and Salt Spray**
    3. **Pretreatment, primer and topcoat.**
4. **Submit written procedure/panels to contracting officer for approval.**

Next Generation Coatings Benefits Summary

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- No heat required – *cuts energy costs!*
- Significantly reduce inner-stage rusting - *improve adhesion & reduce reject rates!*
- Less reaction with metal surface - *generate very little sludge!*
- Shorter treatment time – *increase production throughput!*
- No post treatment required – *decrease chemical handling & costs!*
- No hazardous waste disposal – *reduce labor / chemical costs!*
- Performance – *Meeting Industry Specifications!*

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Thank You